HEATHKIT® MANUAL

HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information ..... (616) 982-3411
Credit ..... (616) 982-3561
Replacement Parts ..... (616) 982-3571

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YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

PORTABLE
AM RADIO
Model GR-1009

595-2604

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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SPECIAL NOTE

To The First-time kit-builder:

Welcome to the exciting world of kit building!

This Portable AM Radio kit is a good choice for a beginning builder because it is easy to build from the carefully planned assembly manual, which explains every step in plain language. It is also a good choice because the finished radio will surprise you with its good tone and volume, even when listening to distant radio stations.

As a first-time kit builder, you will probably find a few words, terms, or symbols that are new to you. These will be explained wherever it is necessary for you to know. In most cases, you can just accept it as a new word or term and watch for the meaning later as you go through the manual. For example, you have probably accepted the fact that there are TRANSISTOR radios without asking what is a transistor. When you check the parts against the Parts List in the Manual, you will see a picture of a transistor along with the part number and description. The same will be true with resistors, capacitors, diodes, and other parts.

During the building of your kit, you will only need to know what a part looks like, and be able to identify its value or type as compared with the Parts List. Later, in the Circuit Description section of the Manual, the parts will be described as to how they work in the electronic circuits.

Heathkit®

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INTRODUCTION

Your Heathkit Model GR-1009 Portable AM Radio will give you pleasure in many different ways, from the fun of kit building to the pride of accomplishment, and the enjoyment of a fine product for years to come. First, you will experience the fun of kit building as you mount the parts and make the solder connections to the foils on the circuit board. You will be pleased with the ease of construction as you proceed through the "Step-By-Step Assembly" instructions. And, you will be filled with the pride of accomplishment when you make the "Initial Test" and "It Works!".

The assembly manual is written in easy-to-understand language with Heath's "We will not let you fail" philosophy. A complete "In Case of Difficulty" section with a Troubleshooting Chart will help you locate and correct a problem if the radio does not work properly. And, the "Circuit Description" is like a short basic course in AM radio theory and operation.

When you have finished the assembly and adjustments of your Radio, you will discover the good volume and clear tone, the sensitivity that lets you tune in distant stations, and the attractive cabinet that is sturdy and easy to clean. Other features that are not as obvious include:

- 8-transistor, 7-diode superheterodyne circuit.
- High-gain ferrite rod antenna.
- 2-inch dynamic speaker with an 8-ohm voice coil.
- Up to 60 hours battery life at 2 hours/day.
- Inexpensive 9-volt transistor battery (not supplied).
- Optional AC Adapter (battery eliminator).*
- Private listening with earphone supplied.

The only tools needed to assemble your radio are:

20- to 30-watt soldering iron.
Small narrow-blade screwdriver.
Small long-nose pliers.
Small diagonal wire cutters.

You will need a 9-volt transistor battery (NEDA #1604) for portable operation. Recommended manufacturers and their battery type numbers are:

Eveready #216
Mallory #TR-146X (long life)

Before you unpack your kit, prepare a work area about 3 feet by 3 feet in size. It should be a table or bench in a place where you will not be in any one's way, and where you will not be bothered while you build your kit.

Place a piece of cardboard or heavy wrapping paper on your work surface to protect it from scratches or solder damage.

* NOTE: Some battery eliminators are called converter/chargers. However, if you use one of these with this Radio, it will not charge the battery. The AC Adapter jack disconnects the battery from the circuit whenever an adapter is plugged in.

PARTS LIST

It is very important that you check the Parts List carefully and identify each part with the description and the Parts Pictorial (Illustration Booklet, Page 1). You will need to recognize and locate the parts again as you assemble your kit. Key numbers in the list refer to the key numbers on the Parts Pictorial.

Circuit component numbers (R2, C4, etc.) indicate the loation of the part on the Schematic Diagram. These component numbers will help you identify the same part in various sections of the Manual, and will be especially useful if a part has to be replaced. They will appear:

— At the beginning of each step where a component is installed.

— In the "Adjustment" section.

— In the "In Case of Difficulty" section.

— In the "Circuit Description".

— In the "Circuit Board X-ray View".

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

Resistors and diodes are taped in a strip, and several of the other parts are in small numbered envelopes to help you identify them. Do not remove the resistors or diodes from the strip, or parts from envelopes, until you are told to do so.

RESISTORS

Resistors are identified in the Parts List and in the assembly steps by their resistance value in Ω (ohms), or kΩ (1,000 ohms). They are also identified by a color code of three or four color bands, where each color represents a number, as in the Resistor Color Code Chart below. The first two color bands, nearest one end, indicate numbers, while the third band is a multiplier. A fourth band, spaced apart from the first three, represents the tolerance or exactness of the resistor's marked value.

Color Code Chart

Examples:

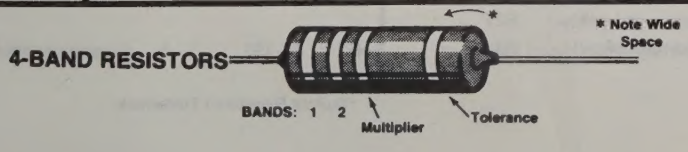
yellow-violet-orange-silver
4 7 ×1000 10% = 47,000 ohms, 10%

red-red-black-gold
2 2 ×1 5% = 22 ohms, 5%

red-red-gold-gold
2 2 ×.1 5% = 2.2 ohms, 5%

RESISTOR COLOR CODE CHART

Band 1 1st Digit		Band 2 2nd Digit		Band 3 Multiplier		Band 4 Resistance Tolerance	
Color	Digit	Color	Digit	Color	Multiplier	Color	Tolerance
		Black	0	Black	1	Silver	±10%
Brown	1	Brown	1	Brown	10	Gold	± 5%
Red	2	Red	2	Red	100	Brown	± 1%
Orange	3	Orange	3	Orange	1,000	None	±20%
Yellow	4	Yellow	4	Yellow	10,000		
Green	5	Green	5	Green	100,000		
Blue	6	Blue	6	Blue	1,000,000		
Violet	7	Violet	7	Silver	0.01		
Gray	8	Gray	8	Gold	0.1		
White	9	White	9				



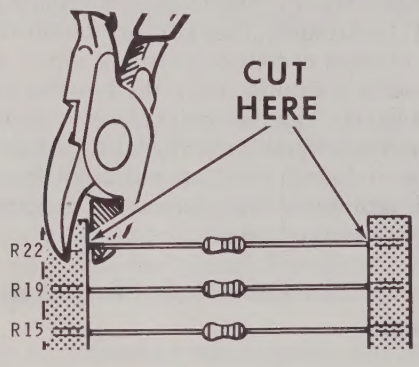
KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

RESISTORS

All resistors in this kit are 1/4 watt, 5% (fourth band gold). The fourth band will not be called out in this Parts List.

To check the resistors, lay the resistor strip alongside the following list. Then compare the color codes to identify their values.

NOTE: As you identify each resistor, mark its "R" number along side of it on the tape. Later, when a step tells you to install R22, for example, find the resistor on the strip and clip its leads close to the tape as shown.



A1	6-229-12	2	2.2 Ω (red-red-gold)	R33, R34
	6-220-12	2	22 Ω (red-red-black)	R4, R36
	6-330-12	1	33 Ω (orange-orange-black)	R17
	6-470-12	1	47 Ω (yellow-violet-black)	R31
	6-471-12	3	470 Ω (yellow-violet-brown)	R11, R12, R21
	6-102-12	1	1000 Ω (brown-black-red)	R5
	6-222-12	4	2200 Ω (red-red-red)	R3, R8, R19, R22
	6-332-12	1	3300 Ω (orange-orange-red)	R18
	6-472-12	1	4700 Ω (yellow-violet-red)	R32
	6-682-12	2	6800 Ω (blue-gray-red)	R15, R16
	6-103-12	2	10 kΩ (brown-black-orange)	R2, R26
	6-153-12	3	15 kΩ (brown-green-orange)	R7, R13, R35
	6-223-12	1	22 kΩ (red-red-orange)	R24
	6-333-12	1	33 kΩ (orange-orange-orange)	R23
	6-473-12	2	47 kΩ (yellow-violet-orange)	R6, R14
	6-124-12	1	120 kΩ (brown-red-yellow)	R27
	6-224-12	1	220 kΩ (red-red-yellow)	R1
	6-334-12	1	330 kΩ (orange-orange-yellow)	R28
	6-394-12	1	390 kΩ (orange-white-yellow)	R29

DIODES

NOTE: A colored tape identifies the cathode (banded) end of the diodes. Leave the diodes attached to the strip until a step tells you to install a diode. Then clip the diode close to the tape, keeping the banded end in mind.

B1	56-26	3	1N191 diode (brown-white-brown)	D1, D2, D3
B2	56-56	4	1N4149 diode	D4, D5, D6, D7

CONTROL

C1	19-748	1	20 kΩ Volume control with on/off switch	R25 SW1

CAPACITORS

Capacitors are illustrated full size in the Parts Pictorial. Compare each capacitor with the keyed pictorial and with the description in the Parts List. The capacitors will have their values printed on them in one of several ways, such as; .05 Z, .001 M, 10, etc. Disregard other numbers that may also appear on the capacitor.

Ceramic

D1	21-3	1	10 pF	C9
D1	21-17	2	270 pF	C4, C6
D1	21-140	2	1000 pF (.001 M)	C23, C25
D2	21-82	1	.02 μF	C7
D2	21-143	5	.05 μF	C2, C3, C5, C11, C21

Mylar*

E1	27-68	2	.0033 μF	C15, C17
E2	27-47	2	.1 μF	C12, C13

Electrolytic

E3	25-900	3	1 μF	C16, C18, C22
E4	25-915	4	47 μF	C14, C24, C26, C27

Variable

E5	26-158	1	2-gang variable	C1, C8

*DuPont Registered Trademark.

Heathkit®

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

ANTENNA — TRANSFORMERS — FILTERS

F1	40-2033	1	Ferrite rod antenna	T1
F2	40-1603	1	Oscillator transformer (red screw)	T2
F2	52-161	1	IF transformer (yellow screw)	T3
F3	404-630	2	455 kHz ceramic filter	F1, F2

TRANSISTORS

NOTE: Transistors are in individual envelopes, marked with a part number. Leave these parts in their envelopes until they are called for in an assembly step.

G1	417-235	2	2N4121 transistor	Q4, Q5
G1	417-801	4	MPSA20 transistor	Q1, Q2, Q3, Q6
G1	417-881	1	MPSA13 transistor	Q7
G1	417-885	1	MPSA65 transistor	Q8

WIRE — CONNECTOR — JACKS

	340-8	1	Bare wire	
	347-55	1	8-wire flat cable	
H1	432-798	1	Battery connector	
H2	436-28	1	AC adapter jack	J1

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

HARDWARE

J1	250-256	2	3-48 × 1/8″ screw
J2	250-1122	1	3-56 × 5/16″ screw
J3	250-389	4	4-40 × 3/4″ black screw
J4	252-731	4	4-40 threaded insert
J5	250-186	2	#4 × 3/8″ self-tapping screw
J6	252-159	1	1/4″ - 32 hex nut
J7	259-6	1	Solder lug

MISCELLANEOUS

K1	401-176	1	Speaker
K2	401-62	1	Earphone with jack
K3	73-124	1	Grommet
K4	390-1889	1	Tuning dial label
K5	85-2585-1	1	Printed circuit board
	305-104	1	Cabinet assembly consisting of:
K6	*92-741*	*1*	*Cabinet top*
K7	*92-742*	*1*	*Cabinet bottom*
K8	*92-743*	*1*	*Battery cover*
K9	462-1118	1	Tuning dial knob
K10	462-1119	1	Volume - on/off knob
		1	Solder
	490-185	1	Soder-Wick*
	490-217	1	Shadow mask
	391-34	1	Blue and white label
	597-260	1	Parts Order Form
		1	Manual (see front cover for part number)

*Registered Trademark, Solder Removal Co.

ASSEMBLY NOTES

The care you use to select and install parts on the circuit board, and in soldering them to the foils, will play a big part in the proper operation of your Radio when it is completed.

These Assembly Notes contain important advice for you to remember. Read all of this section before you begin the Step-by-Step Assembly of your kit.

1. Each step tells you to do something such as mount or install a part, solder a lead, or make an adjustment.

2. Read each step all the way through before you do what it tells you to do.

3. Do exactly what the step tells you to do.

4. As you finish each step, make a check mark (✓) in the space provided, to show that the step is done.

5. Be sure to do each step in the order given and do not skip any steps.

6. Position each part as shown in the Pictorial.

7. The circuit board has a lettered side (with parts outlines and values printed on it) and a foil side (with copper foils). You will mount the parts on the lettered side of the circuit board and solder their leads to the foil side.

8. Resistors will be called out by their resistance value in Ω (ohms) or kΩ (1000 Ω) and by color code. Be sure to read the colors carefully. It is easy to mistake red for brown or orange, for instance, and use a 2200 Ω resistor in place of a 220 Ω or 22 kΩ resistor.

9. Capacitors will be called out by their capacitance values in pF (picoFarad) or μF (microFarad), and by type such as ceramic, Mylar, or electrolytic.

   NOTE:

   picoFarad = .000.001 microFarad
   microFarad = .000.001 Farad

SOLDERING

Soldering is one of the most important operations you will perform while you assemble your kit. A good solder joint will form an electrical connection between two conductors, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 20- to 30-watt pencil type with a 1/8" or 3/16" chisel or pyramid tip works best.

2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet shiny look. This process is called tinning, and it will protect the tip and enable you to make good solder connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

3. Always use rosin core, radio-type solder (60-40 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

GOOD WORK HABITS

Keep your work area clean and clear of parts and tools that you are not using.

Pay attention to what you are doing. Keep your mind on your work. Avoid interruptions.

Don't try to do too much at one time. Take a break when you have finished a page or a section of the Manual. This will help you keep from getting tired, and you will be refreshed for the next part.

STEP-BY-STEP ASSEMBLY

CIRCUIT BOARD ASSEMBLY

START

In the following steps, you will be told how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

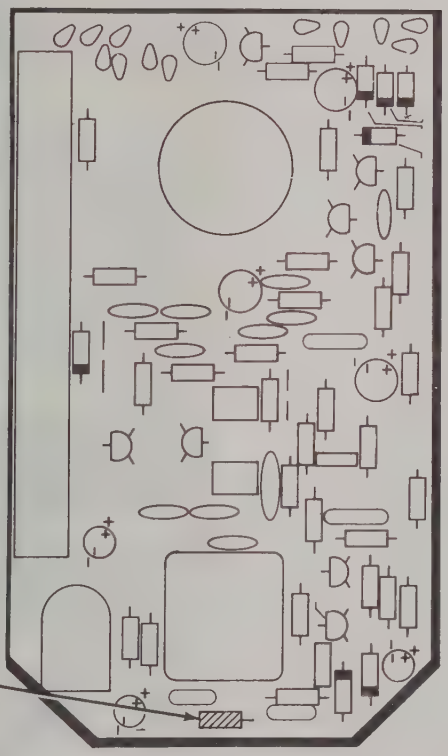
( ) Position the circuit board as shown with the printed side up. The side of the circuit board opposite the printed side will be referred to as the foil side.

( ) Locate R22, a 2200 Ω (red-red-red) resistor on the resistor strip and clip its leads close to the tape.

( ) Hold the resistor lead with long-nose pliers close to the body of the resistor. Then bend the leads straight down to fit the hole spacing in the circuit board.

( ) R22: Push the leads through the holes at the indicated location on the circuit board. The end with color bands may be positioned either way.

( ) Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.

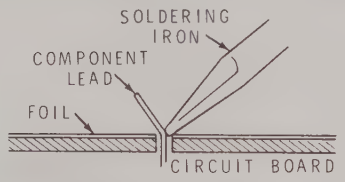


PICTORIAL 1

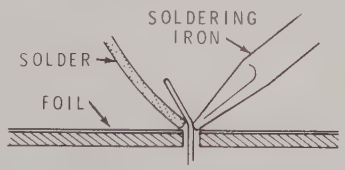
CONTINUE

( ) Solder the resistor leads to the circuit board as follows:

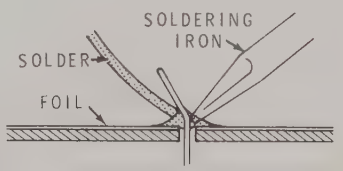
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



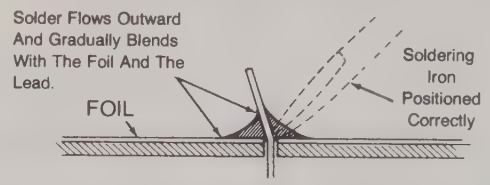
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



( ) Cut off the excess lead lengths close to the connection. WARNING: Clip the leads so the ends will not fly toward your eyes.

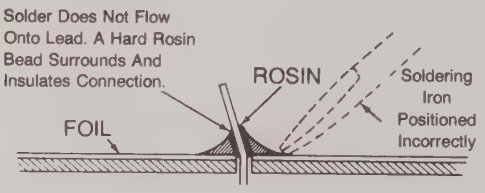
( ) Check each connection. Compare it to the illustrations on Page 10. After you have checked the solder connections, proceed with the assembly on Page 10. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

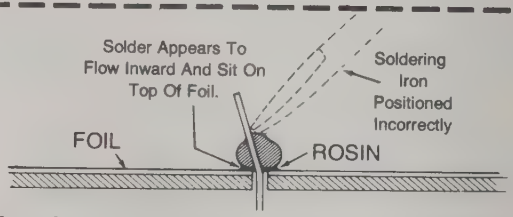


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS


Solder Does Not Flow Onto Lead. A Hard Rosin Bead Surrounds And Insulates Connection.
ROSIN
Soldering Iron Positioned Incorrectly
FOIL

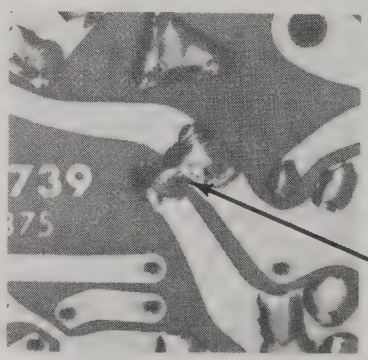
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



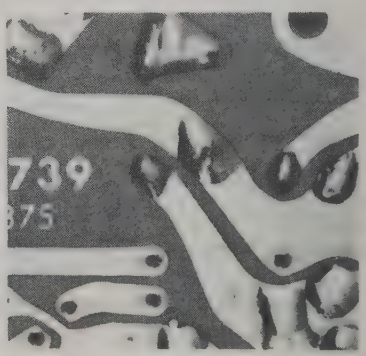
When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.



Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



START

Position the circuit board as shown and install the following resistors. Do not solder the leads to the foil until a step tells you to solder.

NOTE: In the steps in this column, you will install 2.2 Ω, 22 Ω, 2200 Ω, 22 kΩ and 220 kΩ resistors. Be sure the third band color is correct for each resistor you install.

( ) R33: 2.2 Ω (red-red-gold).

( ) R36: 22 Ω (red-red-black).

( ) R34: 2.2 Ω (red-red-gold).

( ) R1: 220 kΩ (red-red-yellow).

SAFETY WARNING: Avoid eye injury when you clip off excess wire ends in the following steps. We suggest that you wear glasses, or at least clip the leads so the ends will not fly toward your eyes.

FOR GOOD SOLDER CONNECTIONS, YOU MUST **KEEP THE SOLDERING IRON TIP CLEAN.** WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) R4: 22 Ω (red-red-black).

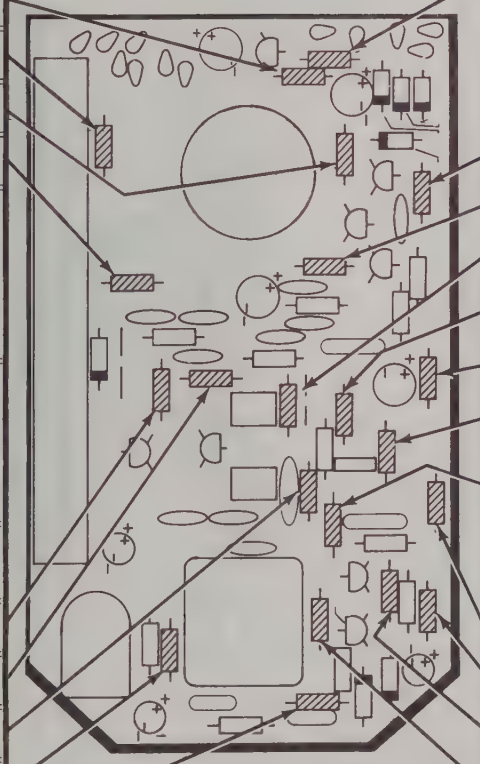
( ) R3: 2200 Ω (red-red-red).

( ) R8: 2200 Ω (red-red-red).

( ) R24: 22 kΩ (red-red-orange).

( ) R19: 2200 Ω (red-red-red).

( ) Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 2

CONTINUE

( ) R35: 15 kΩ (brown-green-orange).

NOTE: As you install 47 Ω, 470 Ω, 4700 Ω, and 47 kΩ resistors in the next seven steps, be sure the third band color is correct for each resistor you install.

( ) R32: 4700 Ω (yellow-violet-red).

( ) R31: 47 Ω (yellow-violet-black).

( ) R6: 47 kΩ (yellow-violet-orange).

( ) R11: 470 Ω (yellow-violet-brown).

( ) R21: 470 Ω (yellow-violet-brown).

( ) R12: 470 Ω (yellow-violet-brown).

( ) R14: 47 kΩ (yellow-violet-orange).

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) R26: 10 kΩ (brown-black-orange).

( ) R15: 6800 Ω (blue-gray-red).

( ) R16: 6800 Ω (blue-gray-red).

( ) R18: 3300 Ω (orange-orange-red).

( ) Solder the leads to the foil and cut off the excess lead lengths.

START

Reposition the circuit board as shown and install the following resistors.

( ) R27: 120 kΩ (brown-red-yellow).

( ) R28: 330 kΩ (orange-orange-yellow).

( ) R29: 390 kΩ (orange-white-yellow).

( ) R2: 10 kΩ (brown-black-orange).

( ) R5: 1000 Ω (brown-black-red).

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) Locate the short piece of bare wire and cut it in half. Bend these wires to form a U for use as jumper wires in the next two steps.

( ) Install a jumper wire at J.

( ) Install another jumper wire at J.

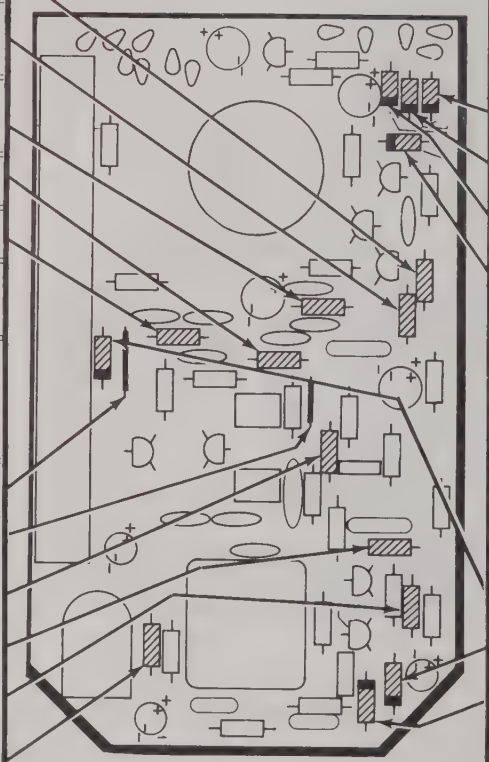
( ) R7: 15 kΩ (brown-green-orange).

( ) R13: 15 kΩ (brown-green-orange).

( ) R17: 33 Ω (orange-orange-black).

( ) R23: 33 kΩ (orange-orange-orange).

( ) Solder the leads to the foil and cut off the excess lead lengths.

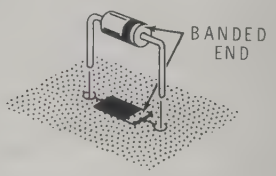


PICTORIAL 3

CONTINUE

NOTE: The diodes you will install in the next seven steps have glass bodies that break easily. Be careful when you bend the leads and install the diode.

Be sure to position the banded end of each diode as shown on the circuit board.



Do not solder the diode leads until you are told to do so.

( ) Locate the four #56-56 (1N4149) diodes on the strip and note the banded ends, which are toward the colored tape. These four diodes will be installed in the next four steps. Clip each diode close to the tape as you install it.

( ) D6: 1N4149 diode (#56-56).

( ) D5: 1N4149 diode (#56-56).

( ) D4: 1N4149 diode (#56-56).

( ) D7: 1N4149 diode (#56-56).

( ) As before, locate the three #56-26 (1N191) diodes. These three diodes will be installed in the following steps.

( ) D1: 1N191 diode (#56-26).

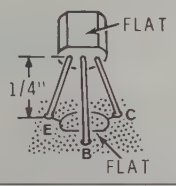
( ) D2: 1N191 diode (#56-26).

( ) D3: 1N191 diode (#56-26).

( ) Check the diodes, in the previous steps, to be sure the banded ends are positioned as shown on the circuit board. Then solder the leads to the foil and cut off the excess lead lengths.

START

IMPORTANT: Install transistors in the manner shown. First line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes, indicated by E, B, and C. Push the transistor down to 1/4" above the circuit board. Solder the leads to the foil and cut off the excess lead lengths.



( ) Q7: MPSA13 transistor (#417-881).

( ) Q8: MPSA65 transistor (#417-885).

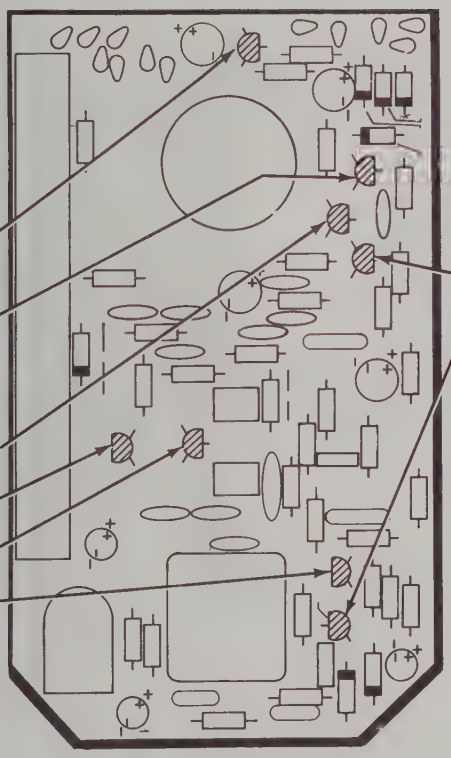
Install MPSA20 transistors (#417-801) at the following four locations.

( ) Q6 .....

( ) Q1 .....

( ) Q2 .....

( ) Q3 .....



CONTINUE

In the next two steps, install 2N4121 transistors (#417-235) at:

( ) Q5.

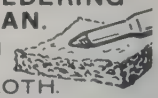
( ) Q4.

( ) Check to see that the correct transistor was installed at each location, and that all leads have been soldered to the foils. Clip off any excess lead lengths that may remain.

PICTORIAL 4

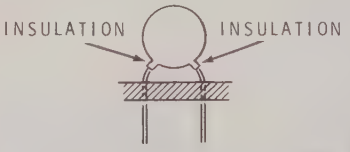
FOR GOOD SOLDER CONNECTIONS, YOU MUST **KEEP THE SOLDERING IRON TIP CLEAN.**

WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.



START

NOTE: When you install ceramic capacitors, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



( ) C25: .001 μF ceramic.

( ) C23: .001 μF ceramic.

( ) C21: .05 μF ceramic.

( ) C11: .05 μF ceramic.

( ) C3: .05 μF ceramic.

( ) C2: .05 μF ceramic.

( ) C5: .05 μF ceramic.

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) C7: .02 μF ceramic.

( ) C4: 270 pF ceramic.

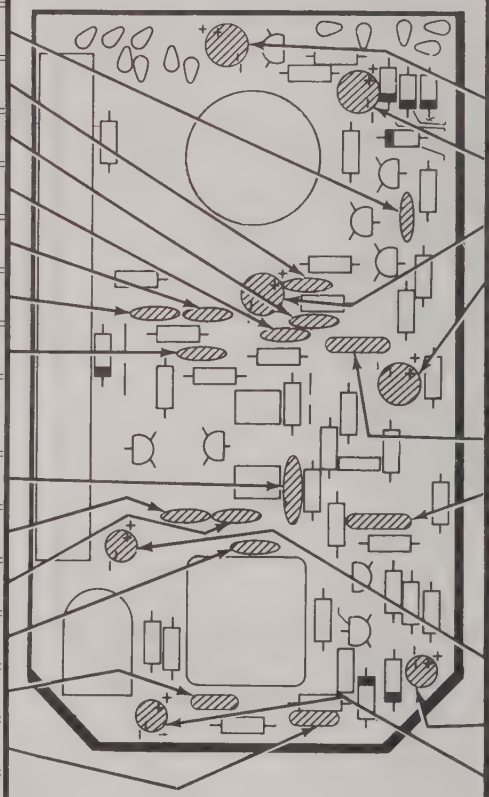
( ) C6: 270 pF ceramic.

( ) C9: 10 pF ceramic.

( ) C17: .0033 μF Mylar.

( ) C15: .0033 μF Mylar.

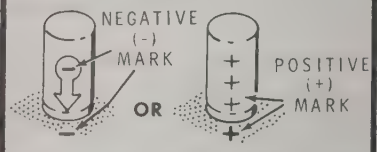
( ) Solder the leads to the foil and cut off the excess lead lengths.



PICTORIAL 5

CONTINUE

NOTE: When you install an electrolytic capacitor, be sure to match the positive (+) or negative (−) marked end of the capacitor with the same marks on the board.



( ) C27: 47 μF electrolytic.

( ) C26: 47 μF electrolytic.

( ) C24: 47 μF electrolytic.

( ) C14: 47 μF electrolytic.

NOTE: The next two Mylar capacitors may be installed with their leads in either holes.

( ) C13: .1 μF Mylar.

( ) C12: .1 μF Mylar.

NOTE: Install the next three capacitors with their positive (+) or negative (−) marks next to the same marks on the circuit board.

( ) C16: 1 μF electrolytic.

( ) C22: 1 μF electrolytic.

( ) C18: 1 μF electrolytic.

( ) Solder the leads to the foil and cut off the excess lead lengths.

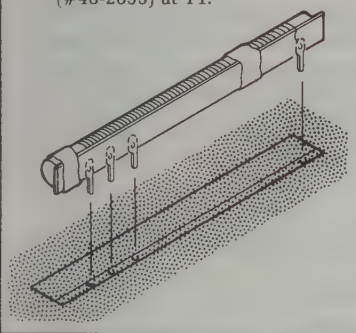
START

NOTE: In each of the next five steps, insert the pins or lugs of the part into their correct holes and push the part against the circuit board. Then solder each pin or lug to the foil.

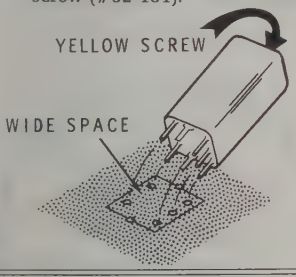
Some foil areas are close together. Do not allow solder to "bridge" from one foil to another.

CLEAN YOUR SOLDERING IRON TIP!

( ) T1: Ferrite rod antenna coil (#40-2033) at T1.

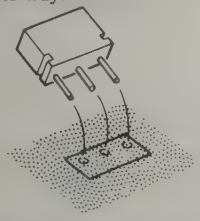


( ) T3: 3F transformer with yellow screw (#52-161).

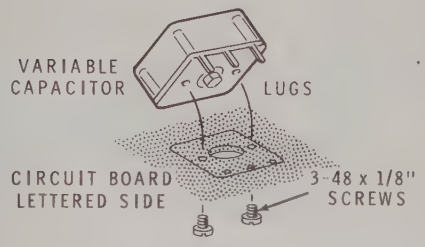


( ) T2: Oscillator transformer with red screw (#40-1603).

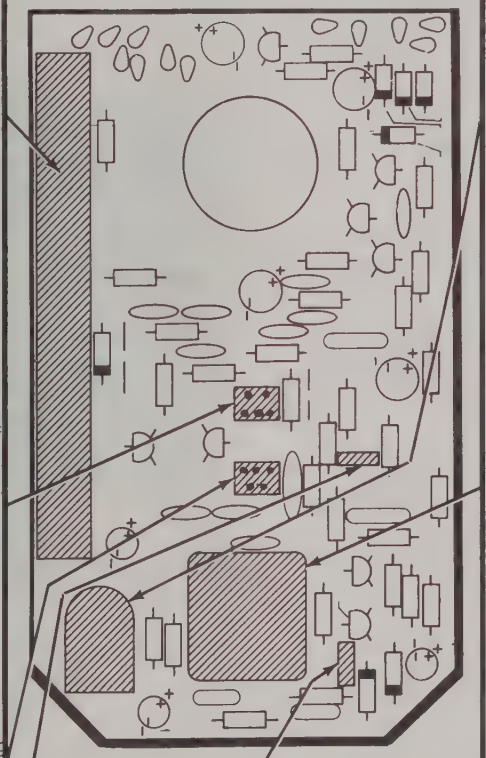
( ) F1: 455 kHz ceramic filter (#404-630). You can mount the filter either way.



( ) F2: 455 kHz ceramic filter (#404-630).



Detail 6A



PICTORIAL 6

CONTINUE

NOTE: The shadow mask (#490-217) is a piece of clear flexible plastic that shows the foil pattern of the circuit board.

( ) Turn the circuit board over and position the shadow mask over the foil. The foil pattern of the mask should cover up the foil on the board. Any solder bridges between foils can now easily be seen. If there is a solder bridge, remove it by holding the soldering iron tip on it. Then allow the excess solder to flow onto the soldering iron tip.

( ) 20 kΩ control (#19-748) at SW1. Fasten the control to the circuit board with a 1/4"–32 hex nut. Then solder the lugs to the foil and cut off the excess lug lengths.

( ) C1: Check the three lugs on the variable capacitor and straighten them, if necessary, as shown in Detail 6A. Then mount the capacitor at C1 on the lettered side of the circuit board. Fasten the capacitor with two 3-48 × 1/8" screws from the foil side. Then solder the three lugs to the foils and cut off the excess lengths.

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

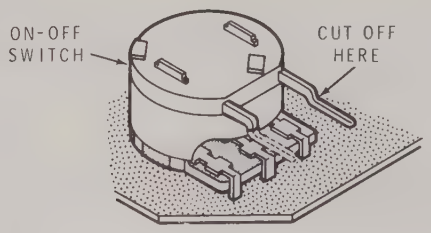
( ) Solder bridges between foils.

( ) Protruding leads which could touch together.

( ) Transistors for the proper **type** and **installation**.

( ) Electrolytic capacitors for the correct position of the positive (+) end.

( ) Diodes for the proper type and correct position of the banded end.



Detail 7A

CIRCUIT BOARD WIRING

Refer to Pictorial 7 (Illustration Booklet, Page 2) for the following steps.

( ) Use diagonal wire-cutters to cut off the ends of both lugs of the on/off switch as shown in Detail 7A.

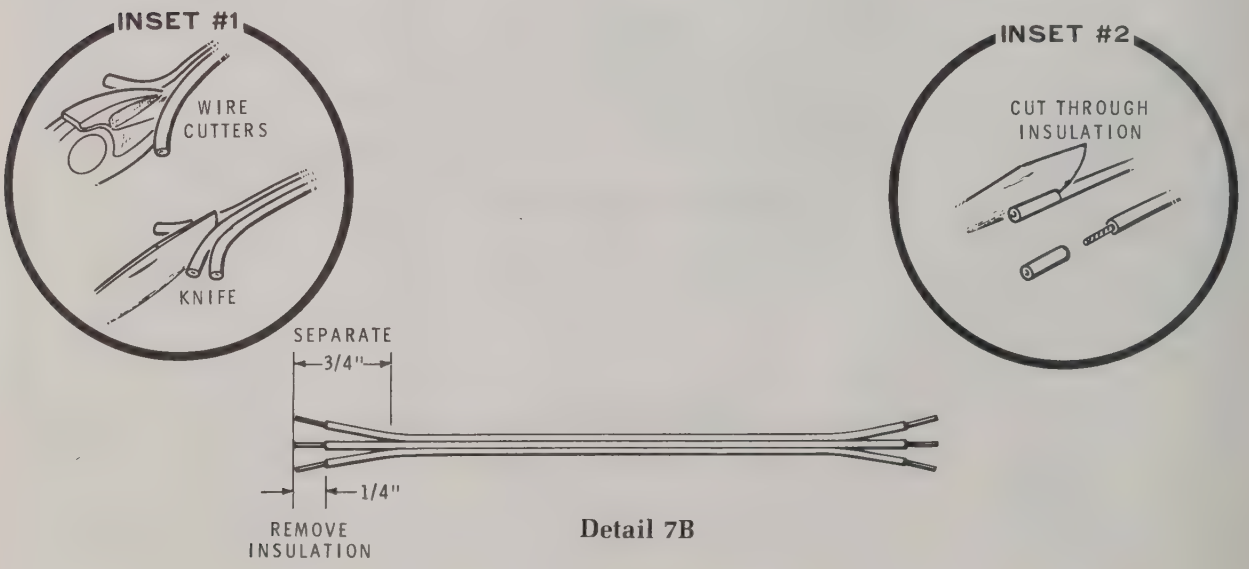
( ) Refer to inset drawing #1 of Detail 7B and separate the 8-wire flat cable to make three flat cables as follows:

Brown-red-orange
Yellow-green-blue
Violet-gray

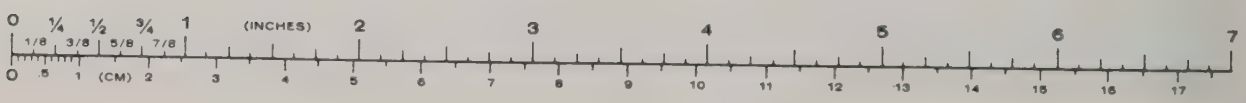
NOTE: When you prepare a cable, as in the following steps, first cut the cable to the given length. Then refer to Detail 7B and separate the wires 3/4" at each end of the cable. Remove 1/4" of insulation from both ends of each wire as shown in inset drawing #2. Finally, apply a small amount of solder to hold the fine wire strands together.

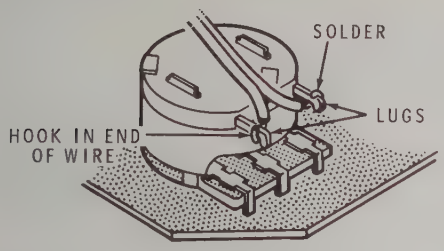
( ) Prepare the following lengths of flat cables:

5-1/2" violet-gray
3" violet-gray
4" yellow-green-blue
4" brown-red-orange



Detail 7B





Detail 7C

( ) Refer to Detail 7C and form a small hook in each wire at one end of the 5-1/2″ violet-gray cable. Connect and solder the hook in the gray wire to either lug of the on/off switch. Then connect and solder the violet wire to the other lug.

( ) At the free end of the same violet-gray cable, connect and solder either wire to hole G, and the other wire to hole H. Position the cable along the circuit board as shown in Pictorial 7.

( ) Connect and solder one end of the 3″ violet-gray cable to the circuit board with violet to hole B, and gray to hole C. The other end of this cable will be connected later.

( ) In the same manner, connect and solder one end of the 4″ yellow-green-blue cable as follows:

Yellow to hole D.
Green to hole E.
Blue to hole A.

( ) Connect and solder the 4″ brown-red-orange cable as follows:

Brown to hole K.
Red to hole J.
Orange to hole F.

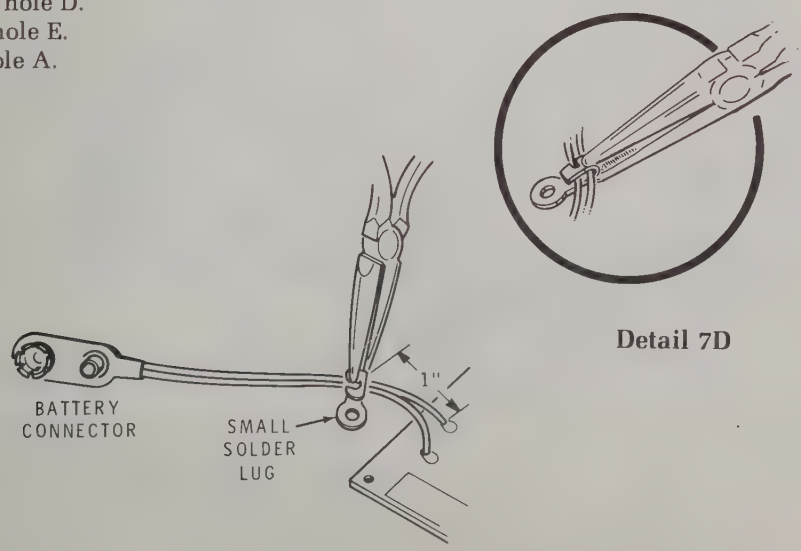
The other end of these cables will be connected later.

( ) Locate the battery connector and cut the red wire and black wire 4″ from where they enter the connector insulator. Remove 1/4″ of insulation from the ends of the wires and apply a thin coating of solder to hold the fine wire strands together.

( ) Connect and solder the red battery connector wire to hole I on the circuit board. Then connect and solder the black wire to hole L.

( ) Refer to Detail 7D and install a small solder lug on the battery connector wires, 1″ from the circuit board. Crimp the end of the solder lug around both wires. This will serve as a battery wire retainer.

( ) Examine the foils at the end of the circuit board where you have connected the cable wires. Cut off the excess lead lengths at the foils. Then check for solder bridges or poorly soldered connections.



Detail 7D

Refer to Pictorial 8 (Illustration Booklet, Page 2) for the following steps:

In the following steps, you will connect the free ends of the cables to lugs on the AC adapter jack and earphone jack. These jacks are very small and their contacts bend easily. Handle them carefully.

To hold the jacks steady while you connect and solder wires to their lugs, temporarily mount them in their slots in the cabinet front as follows:

( ) Lay the cabinet top face down on a clean, soft cloth to protect the face of the cabinet.

( ) Locate the AC adapter jack (#436-28) and loosen its nut and washer to near the end of the threads. Then refer to Detail 8A and slide the jack down into its slot in the end of the cabinet top.

( ) In the same manner, mount the earphone jack (packaged with the earphone) in the other slot in the end of the cabinet top.

( ) Tighten the nuts on both jacks until they are just snug, and position their lugs as shown in Pictorial 8.

( ) Position the circuit board as shown, then bend a small hook in the free end of each wire coming from the circuit board.

( ) Connect and solder the brown-red-orange cable wires to the AC adapter jack as follows:

Brown to lug 1.
Red to lug 2.
Orange to lug 3.

( ) Connect and solder the yellow-green-blue cable wires to the earphone jack as follows:

Blue to lug 1.
Green to lug 2.
Yellow to lug 3.

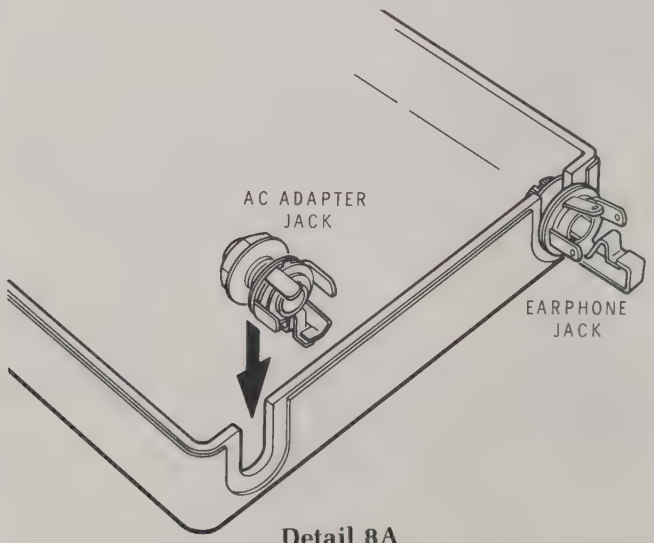
In the next two steps, you will connect the violet-gray cable wires to the speaker. Handle the speaker very carefully so you do not damage the paper cone. Be especially careful when you solder to the speaker lugs; the soldering iron tip or drops of hot solder must not be allowed to touch the cone.

( ) Connect and solder the violet wire to lug 1.

( ) Connect and solder the gray wire to lug 2.

( ) Carefully inspect the connections at the speaker lugs and the two jacks. Be sure all connections are well soldered, and that no wire ends touch other wires or lugs. Cut off any excess wire ends.

( ) Remove the two jacks from the slots in the cabinet front and set the cabinet front aside.



Detail 8A

VISUAL CHECKOUT

Although several checkouts were included in the assembly steps, it is important that you double-check your work before you connect the battery and finish the assembly. Components in your Radio could be damaged by an incorrectly installed part, or by a solder bridge between two foils.

> If you must remove or replace a part on the circuit board, use the Soder-Wick as described on its package to remove the solder from the leads and foils; then gently remove the part. When you replace a part, be sure to solder the leads.

Examine each part mounted on the circuit board and make sure:

1. The correct part is in each location.
2. Electrolytic capacitors have their + or − leads in the proper holes.
3. Diode banded ends are in the right direction.
4. Transistor flat sides match their outlines and the E, B, and C leads are in the correct holes.

Use a magnifying glass to examine the circuit board for poor solder connections or connections you may have missed and not soldered. Look closely for solder bridges across two or more foils, or excess lead lengths shorting together. Compare the foil areas with the shadow mask, and check very carefully around T2 and T3 where foils are very close to each other.

If you are in doubt about a solder connection, clean and tin your soldering iron tip and reheat the connection. Excess solder will flow onto the soldering iron tip. You can also remove excess solder by applying the Soder-Wick to the melted solder.

( ) Check for bits of solder or wire ends that might have fallen between leads or across foils on the circuit board.

( ) Be sure the correct wire color is properly soldered to each lettered hole in the circuit board.

When you are satisfied that all parts are correct and connections are properly made, and that there are no solder bridges, proceed with the Initial Test that follows.

INITIAL TEST

( ) Place the circuit board and speaker on a non-metallic surface such as wood, cardboard, or cloth.

Refer to Figure 1, below, for the following steps.

( ) Use a small narrow-bladed screwdriver (no wider than 1/4") and preset trimmer capacitors C1 and C8 to the positions shown. Observe the position of the plates inside the plastic case of the tuning capacitor as well as the position of the screw slots.

( ) Connect the battery connector to the battery and rotate the shaft of the VOLUME control clockwise to turn the Radio on. Turn the shaft further clockwise until you hear sound (noise) from the speaker. Caution: Do not force the shaft past the end of its rotation.

( ) Rotate the shaft of the TUNING capacitor from one extreme to the other. If you hear a radio station, or static, such as noise from a fluorescent light, turn off the radio and proceed with the speaker and knob installation. However, if you do not receive any sounds from the speaker, disconnect the battery and turn to the "In Case Of Difficulty" section on Page 26. When you have corrected the problem, return to this step.

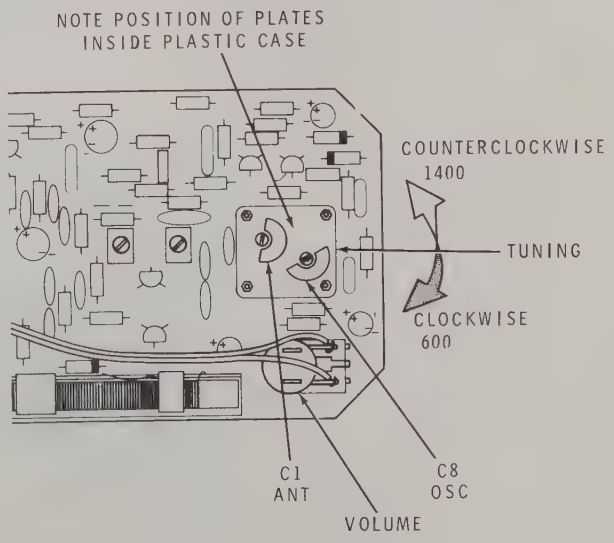
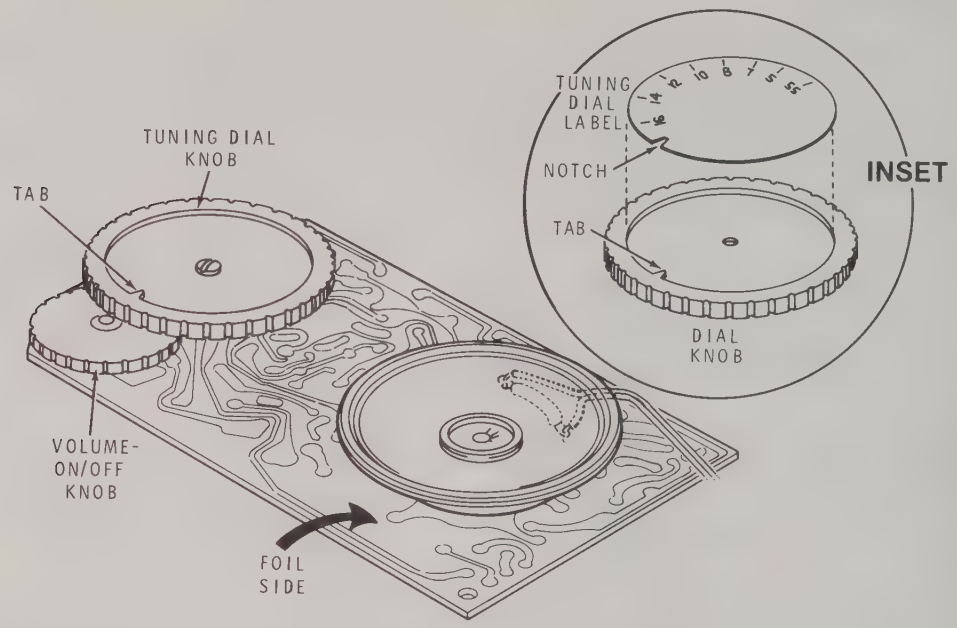
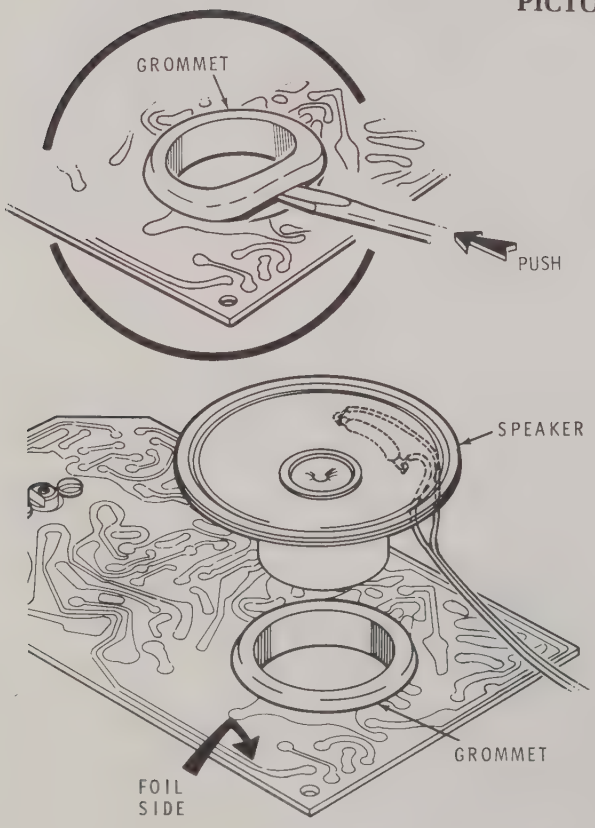


Figure 1



PICTORIAL 9



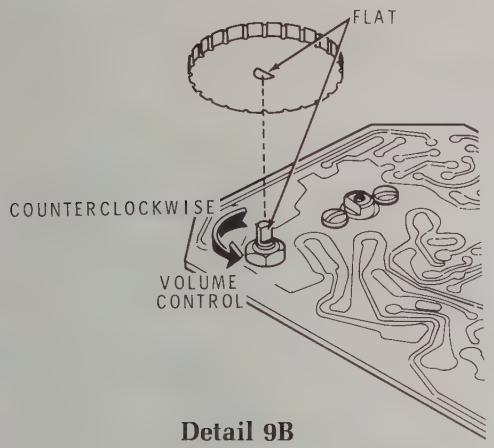
Detail 9A

SPEAKER AND KNOB INSTALLATION

Refer to Pictorial 9 for the following steps.

( ) Install the large rubber grommet in the speaker hole of the circuit board as shown in Detail 9A. Be sure the grommet is seated all the way around on both sides of the circuit board.

( ) Press the speaker into the rubber grommet from the foil side of the circuit board. Position the speaker lugs and the violet-gray cable as shown in the Pictorial.



Detail 9B

As you install knobs in the next two steps, lay the circuit board (foil side up) on a flat firm surface. This will support the volume control and tuning capacitor to avoid stress on the circuit board.

( ) Refer to Detail 9B and rotate the shaft of the volume control fully counterclockwise. Then line up the flat in the center of the volume control knob with the flat on the control shaft. Press the knob onto the shaft as far as it will go.

( ) Refer to Detail 9C and rotate the shaft of the tuning capacitor fully clockwise. Then install the tuning dial knob on the shaft with its surface tab to the left as shown in Pictorial 9. Secure the knob to the shaft with a 3-56 × 5/16″ screw.

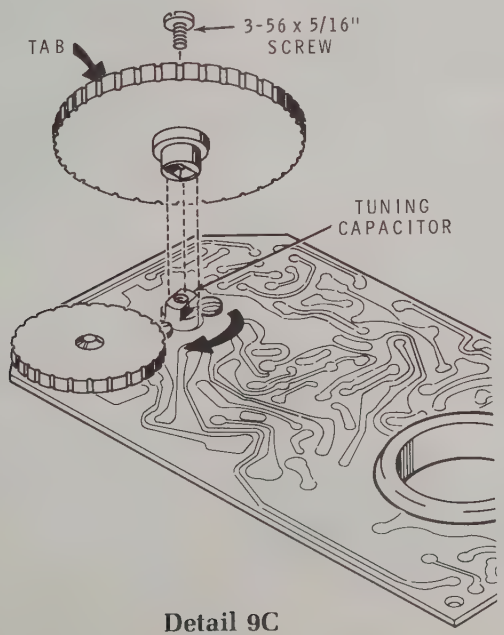
CAUTION: When you install the tuning dial label in the following steps, be very careful to position the label accurately. Once you have installed the label, removal will be very difficult without damaging or destroying the label.

( ) Be sure the tuning dial knob is turned fully clockwise.

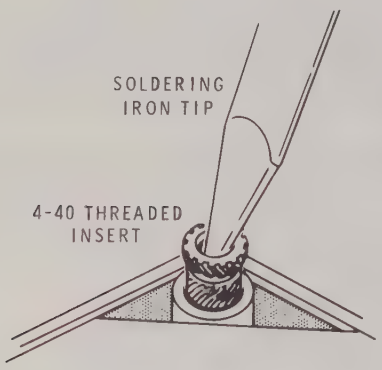
( ) Refer to the inset drawing on Pictorial 9 and examine the tuning dial label for the position of the notch. Also note the position of the tab on the surface of the tuning dial knob.

( ) Remove the paper backing from the tuning dial label and carefully place the label on the tuning dial knob with the notch over the tab. The label should be evenly spaced inside the raised edge of the knob. Then press the label to the knob by rubbing it with your finger.

( ) Peel the protective film from the tuning dial label.



Detail 9C



Detail 10A

CIRCUIT BOARD MOUNTING

Lay the cabinet top face down on a clean soft cloth to avoid marring its surface. Then refer to Pictorial 10 (Illustration Booklet, Page 3) for the following steps.

Refer to Detail 10A and install threaded inserts in the four corner holes of the cabinet top as follows:

( ) 1. Set a 4-40 threaded insert with its small end in a corner hole.

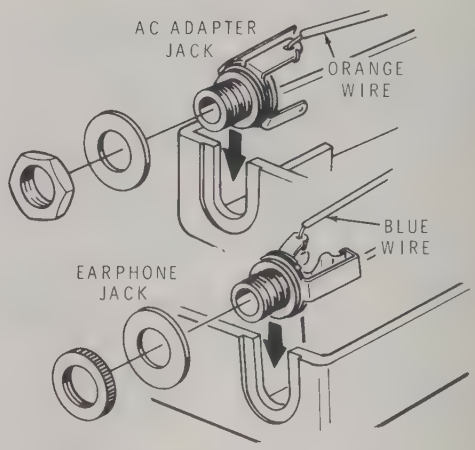
( ) 2. Clean the tip of your soldering iron. Then touch the tip of your soldering iron to the top of the insert.

CAUTION: Do not let the hot soldering iron touch anything except the top of the insert.

( ) 3. As the heated insert softens the plastic around the hole, press the insert straight into the hole so its top is just below the top of the hole.

( ) 4. Remove the soldering iron tip and let the insert cool while you install another insert.

( ) Position the circuit board as shown in Pictorial 10. Then slide the tuning dial and volume control knobs into their openings at the end of the cabinet top and rest the circuit board on the two mounting posts.



Detail 10B

( ) Secure the circuit board to the mounting posts with two #4 × 3/8″ self-tapping screws. Be sure the battery wire retainer is installed as shown.

When you install jacks in the next two steps, handle them very carefully: their contacts and lugs are small and easy to bend. Do not force a jack into its slot. Position each jack so the wires indicated in Detail 10B are up.

( ) Refer to Detail 10B and mount the AC adapter jack as shown. Be sure the washer is on the outside of the cabinet. Carefully position its wires under the edge of the circuit board as shown in Pictorial 10. Tighten the nut on the jack.

( ) In the same manner, mount the earphone jack and position its wires as shown, then tighten the nut.

( ) If it has not already been done, connect the battery to the battery connector and insert the battery in its compartment.

This completes the "Step-By-Step Assembly" of your Radio. You will install the cabinet bottom later in "Final Assembly." Proceed to "Adjustments".

ADJUSTMENTS

Four adjustments in this receiver tune (or align) the circuits for maximum gain and sensitivity. It is very important, for best reception and performance, that you make these adjustments carefully and exactly as described in the following steps.

Refer to Figure 2 (Illustration Booklet, Page 4) for the locations of the four adjustment screws.

NOTE: You will use static or radio frequency noise as a signal source while you make the next two adjustments. Turn on a nearby fluorescent lamp, electric shaver, or food mixer. Either of these should produce enough RF noise for you to make the adjustments. Also, you may hear a radio station as you rotate the Tuning dial. DO NOT use a radio station signal for the adjustments unless you are told to do so.

Be sure the Radio is face down on your work surface, as shown in Figure 2.

1. ( ) Rotate the VOLUME control thumbwheel counterclockwise to turn on the Radio. Then adjust the volume until noise (static) is heard.

2. ( ) Rotate the TUNING dial fully clockwise (dial pointer at 55). If you hear a station, turn the TUNING dial slightly to where no station is heard. Then adjust the RED screw in oscillator transformer T2 for the loudest noise. (Do not turn this screw more than one-half turn in either direction).

NOTE: Transformer T3, with the yellow adjusting screw, was preset at the factory and will need very little adjustment. For best results, use the earphone when you make the following adjustment.

( ) Tune in a weak station near 600 kHz. (6 on the dial). Then adjust the YELLOW screw in transformer T3 very slowly until the station is loudest. DO NOT turn the screw more than 1/4 turn in either direction.

In the following steps, you will tune the receiver so the dial will indicate the frequency of the radio station being received. You will need to know the frequency of a station around 1400 kHz (14 on the dial). Most radio stations give their frequency when they give their call letters, or you can find the frequency of a local station listed in the radio program section of your local newspaper.

NOTE: If you must use a distant station for this frequency, remember that distant stations come in better at night.

( ) Tune in a station near 14 on the dial whose frequency you know, and check to see if the dial closely indicates the station frequency. Note that a station operating at 1400 kiloHertz should be received at exactly 14 on the dial, while 1420 kiloHertz would be slightly past 14. If the dial setting matches the radio station frequency, skip the following step.

( ) While listening to the station, turn the dial very slightly toward its correct dial setting and adjust OSC trimmer C8 to tune in the station. Repeat this step until the dial indicates the exact frequency of the radio station, even if it seems weaker in volume. It will be louder after the next step.

( ) Tune in a weak station between 12 and 15 on the dial and adjust ANT trimmer C1 for the loudest signal.

( ) Return to Step 2. and repeat the adjustments until stations come in the loudest and at the right points on the dial. You may have to repeat the adjustments three or four times.

This completes the Adjustments of your Receiver. You may turn the Radio off, or keep listening as you complete the "Final Assembly".

FINAL ASSEMBLY

Refer to Pictorial 11 for the following steps.

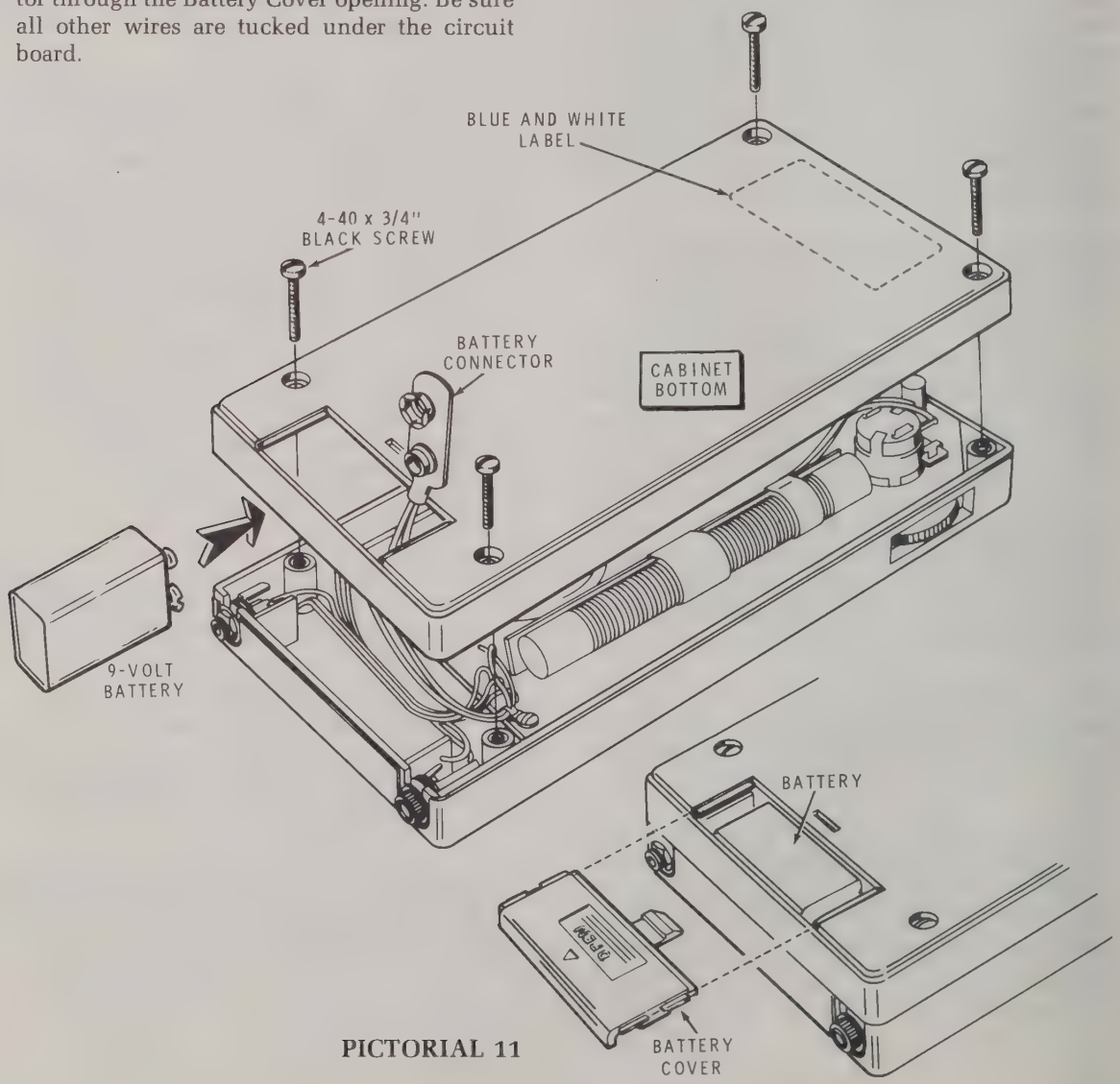
( ) Peel the paper backing from the blue and white label. Press the label firmly to the inside of the cabinet bottom. If you correspond with Heath Company about this radio, be sure to mention the series number printed on the label.

( ) Position the cabinet bottom as shown; then disconnect the battery and pass the battery connector through the Battery Cover opening. Be sure all other wires are tucked under the circuit board.

( ) Place the cabinet bottom on the cabinet top and secure with four 4-40 × 3/4″ black screws.

( ) Connect the battery to its connector and install it in the battery compartment. Then slide the battery cover into place.

Your Portable AM Radio is now completely adjusted and assembled, ready to provide you with many hours of happy listening.



PICTORIAL 11

OPERATION

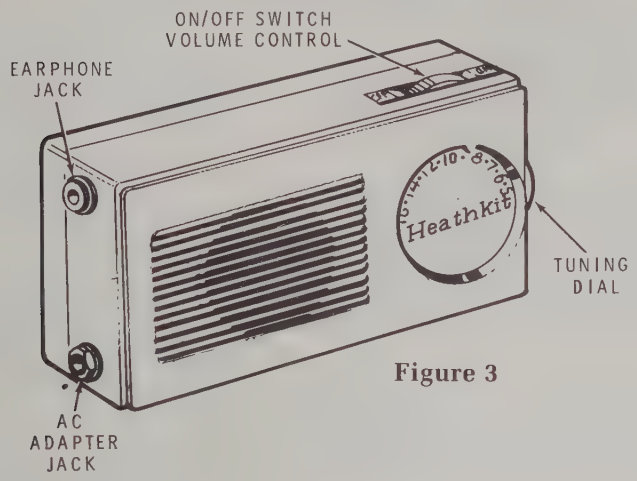


Figure 3

Refer to Figure 3 for the location of the controls and jacks referred to in this Operation section of the Manual.

HOW TO OPERATE YOUR RADIO

1. Turn the VOLUME control clockwise to turn the Radio on, then further clockwise to adjust the volume to a desired listening level.

2. Turn the TUNING dial to select the desired AM radio station.

Private listening with the earphone supplied is provided by the earphone jack on the end of the cabinet. You can also connect a larger 8-ohm speaker to the earphone jack to enjoy improved tone and greater volume.

An accessory AC adapter (Heath Model PS-2350) can be connected to the AC adapter jack to operate the Radio from any 120 volt AC power line. When the Adapter is plugged into the adapter jack, the internal battery is automatically disconnected from the circuit. This prevents a "charger" from damaging a battery that is not designed to be charged.

Your Radio has a ferrite rod antenna that has a directional receiving pattern. Reception of a weak or distant station may be improved by turning the Radio so its long side faces the station as shown in Figure 4 (Illustration Booklet, Page 4).

The directional feature also makes your Radio a good emergency direction finder. Simply tune in a radio station whose location you know; then turn the Radio until the station comes in the loudest. The long side of the cabinet will face the direction of the radio station.

Reception in cars, trains, planes, or trailers may be weak because of their metal bodies. However, if you place the Radio near a window, the reception should be satisfactory. Do not leave the Radio in direct sunlight — such as the rear deck of a car. Very high temperatures can develop and damage the radio.

BATTERY CARE

A good quality 9-volt transistor battery will give up to 60 hours of operation if your Radio is used only two hours a day. The total battery life will be reduced if the Radio is used for longer periods each day.

To get the most out of your battery, be sure to turn the Radio off whenever it is not being used. Also, keep the volume at a moderate listening level. Excessive volume uses more battery power and shortens battery life.

When the battery becomes weak, the Radio will sound "tinny" and have low volume. When this happens, replace the battery at once. A weak or "dead" battery may leak chemicals and corrode parts inside your Radio.

CAUTION: DO NOT STORE THE RADIO FOR LONG PERIODS OF TIME WITHOUT REMOVING THE BATTERY.

IN CASE OF DIFFICULTY

This section of the Manual is divided into several parts. The first part, titled "General Troubleshooting" tells you what to do if your Radio does not work right when you first turn it on during the Initial Tests.

Another part, titled "Point-To-Point Tests", will help you track down a problem if General Troubleshooting fails, or if the Radio quits after it has been working okay. A chart in the Point-To- Point Tests should lead you to the area of the problem, and then tell you which parts to check.

Repeat the "Initial Test" on Page 19 whenever you find and correct a suspected error. If the Radio still does not work right, return to where you left off in this section of the Manual.

A section titled "Use of Test Equipment" (Page 29) is included for those who have a volt-ohmmeter, to check voltages at various key points and to measure resistances of suspected components.

GENERAL TROUBLESHOOTING

1. Repeat the steps under "Visual Checkout" on Page 19. You might have missed something the first time. You might also have someone who is not familiar with the kit go through the Visual Checkout. They may notice something that you have overlooked.

2. About 90% of the kits that are returned to the Heath Company for repair have poor solder connections. That is why it is so important for you to recheck all the solder connections to make sure they are good. If you are in doubt, reheat each connection and make it good. Read again the section on "Soldering" on Page 8.

3. Check the battery. Sometimes a "brand new" battery is weak from sitting on a store shelf for too long. Try the battery in another transistor radio or recorder that you know is working properly.

4. Check the AC adapter jack and the earphone jack for bent contacts. Either jack could prevent the Radio from operating.

5. Check the values of the parts. Go through the circuit board assembly Pictorial steps to be sure the proper part was mounted at each location. It would be easy, for instance, to mistake a 4700 Ω (yellow-violet-red) resistor for a 470 Ω (yellow-violet-brown) resistor.

6. Recheck the diodes and transistors. Be sure the correct type is mounted at each location and that their leads are in the proper holes. Check the banded ends of diodes and the E, B, and C leads of transistors.

If this General Troubleshooting does not help you find the problem, make the "Point-to-Point Tests" that follow.

POINT-TO-POINT TESTS

You do not need instruments to make these Point-to-Point Tests, which should lead you to the general area of the problem. Use these tests when you get no sound, or when you get noise but no radio station.

Figure 5 (Illustration Booklet, Page 4) shows the location of the Test Points (TP) that are used.

Hold a narrow-bladed screwdriver so your finger touches the blade. Then touch the tip of the blade to the indicated test point. Listen for the proper sound as listed in the chart. If it is right, go to the next test point. If you do not get the proper sound when you touch a test point, look in the third column for a possible cause of trouble.

The Circuit Description on Page 31, the Block Diagram, and the Schematic Diagram all use the test points for reference. Use these for greater help in locating a problem in your Radio. Refer to the "Circuit Board X-Ray View" for the physical location of parts on the circuit board.

POINT-TO-POINT TEST CHART

The following tests (Page 28) must be made with a good battery installed (or with the accessory AC Adapter). The Radio must be turned on and the Volume control turned fully clockwise. The Tuning dial should be set at "6".

The point-to-point tests will be made on the component side of the circuit board.

Touch ONLY the indicated test point. DO NOT let the screwdriver tip touch two points or component leads at once. This could cause a short circuit and damage components in your Radio.

TOUCH TEST POINT	PROPER SOUND	POSSIBLE CAUSE OF TROUBLE (if proper sound is not heard)
TP1	A. No sound. B. Faint static or noise.	1. Bent contacts on jacks. 2. Battery dead. 3. Transistors Q7 and Q8 interchanged or improperly installed. 4. Transistors Q5 and Q6 interchanged or improperly installed. 5. Resistors R33, R34, R35 and R36, or capacitor C26 interchanged with other parts. 6. Diodes D4, D5, D6 or D7 incorrectly installed.
TP2	Moderate static or noise.	1. Transistor Q5 or Q6 incorrectly installed. 2. Resistors R26, R27, R28, R29, R31 or capacitors C22 or C24 interchanged with other parts.
TP3	Moderate click when touched.	1. Diodes D2 or D3 incorrectly installed. 2. Resistors R18, R19, R22, R23, R24, or capacitors C15, C16, or C17 interchanged with other parts.
TP4	Moderate click when touched followed by moderate static.	1. Transistor Q4 incorrectly installed. 2. Resistors R15, R16, or R17 interchanged with other parts.
TP5	Loud static or buzz.	1. Transistor Q3 incorrectly installed. 2. Resistors R13, R14, R15, R16, or capacitors C12, C13, or C14 interchanged with other parts.
TP6	Moderate click when touched followed by faint static.	1. Transformer T3, resistor R11, or filter F1 incorrectly installed.
TP7	Loud static or buzz.	1. Transistor Q2, resistor R8, R13, or capacitors C6, C7 or C11 incorrectly installed or interchanged with other parts.
TP8	Loud static or buzz.	1. Transistor Q1, resistors R2, R3, R4, R5, R6, R7 or capacitors C8A and C8B, C9, or C16 incorrectly installed or interchanged with other parts.
TP9	Loud static or buzz.	1. L1 (antenna) either open or shorted. 2. Capacitors C1A or C1B shorted.

USE OF TEST EQUIPMENT

If you can use a high-input impedance volt-ohmmeter, you may be able to trace a problem if you measure voltages and resistances in your Radio. The Schematic Diagram shows the correct voltages at various key points, and the "Circuit Board X-Ray Views" will help you locate those points.

CAUTION: Be careful when you test transistor circuits. They are easily damaged by excessive voltage or current. Touch the probe tip only to the indicated test point. DO NOT let the probe slip and short across nearby foils or wire ends.

If the tests show a big difference in voltage at a given point, you can check the resistances of components around that point. Resistors, capacitors, and diodes can usually be checked while connected in the circuits, while a suspected transistor should be removed from the circuit board for testing.

When you measure across a resistor, the ohmmeter should read the same value as indicated by the color code on the resistor. A lower reading may be found where the resistor parallels another component.

A ceramic capacitor should show very high or infinite resistance. But if there is a resistor in parallel with the capacitor, the meter reading may be affected by the value of the resistor. Electrolytic capacitors should read a fairly low resistance when the leads are first applied, and then rise to a high resistance depending on whether a resistor is in parallel with the capacitor.

A diode should measure high resistance in one direction and low resistance with the test leads reversed. A high resistance in both directions indicates an "open" diode, while a low resistance in both directions indicates a "shorted" diode.

If you suspect a transistor to be faulty, you must remove it from the circuit. Use Soder-Wick to remove the solder from each transistor lead connection on the circuit board foil. Then gently pry the transistor leads loose. Test the transistor in the following manner:

1. Set your ohmmeter on the R × 1000 range.

2. Connect one of the ohmmeter leads to the base (B) of the transistor. NOTE: This is the center lead on all transistors in this Radio.

3. Touch the other ohmmeter lead to the emitter (E) and then to the collector (C) of the transistor. Both readings should be the same, either high or low. If one reading is high and the other low, replace the transistor with a new one of the same type.

4. Reverse the ohmmeter lead connection to the base (B) and repeat step 3. The readings should be equal at the E and C leads, but **opposite** of the readings taken with the other lead connected to the base (B). That is, if the reading were low with the ohmmeter leads connected one way, they should be high in this test, etc.

NOTE: In the event that all readings are either high or low, no matter which ohmmeter lead is connected to the base, the transistor is faulty and must be replaced.

5. Connect one ohmmeter lead to the emitter (E) of the transistor and touch the other lead to the collector (C). If the reading is low, replace the transistor.

6. Repeat step 5 with the meter leads reversed. The reading should again be high. If not, replace the transistor.

If you are unable to resolve a difficulty in your Radio, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is printed on the inside front cover.

SPECIFICATIONS

Tuning Range	535 - 1605 kHz.
Intermediate Frequency (IF)	455 kHz.
Sensitivity	600 μV/m (microvolts per meter) for 20 dB signal-to-noise ratio or 250 μV/m for 10 dB signal-to-noise ratio.
Audio Output Power	0.2 watt (200 milliwatts).
Speaker	2″ round, .5 oz. permanent magnet, 8 Ω voice coil.
Power Requirements	9-volt transistor battery, NEDA type 1604.
Current Drain	Approximately 4 milliamperes with Radio turned on and volume set to minimum level. Approximately 15 milliamperes with Radio turned on and volume set to normal level.
Dimensions	3-1/4″ high × 6-3/8″ wide × 1-1/4″ deep (8.3 × 16.2 × 3.2cm).
Net Weight (without battery)	1 lb. 450 grams.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

While most everyone knows how to turn on a radio and tune in a station, many people may never think about how that voice or music is sent through the air to come out the speaker of their radio. But then, not everyone has built their own AM Radio.

Because you might want to know "how it works" in general, rather than in complex electronic terms, this Circuit Description is presented in two parts. The first part is a Basic AM Radio Theory for those who want just the fundamentals. The second part, intended for those with an understanding of electronics, explains in detail how each electronic circuit functions in the radio.

BASIC AM RADIO THEORY

Sound - Audio Signals

Sounds, such as voice, music, bells, car horn, etc., are vibrations that carry through the air as "sound waves". When these sound waves reach your ear, they vibrate the ear drum and are "heard" as in Figure 6A (Illustration Booklet, Page 4). You can feel sound vibrations if you place your finger on the cone of a loudspeaker, or hold a thin piece of paper or metal in front of your mouth as you talk or sing.

A microphone changes sound-wave vibrations into electrical impulses of the same characteristics or wave pattern. These impulses are called an "audio signal" and are amplified for use in various ways as shown in Figure 6B. One use of the amplified audio signal is to drive a public address or intercom loudspeaker, which changes the audio signal back into sound waves. The audio signal can also be recorded on plastic disks or on magnetic tape for replay later. Amplified audio signals from a microphone, phonograph record, or tape player are used to modulate a radio station carrier and sent out over the air.

If you want to see what an audio signal looks like, take a strong magnifying glass and look at the grooves in one of your phonograph records. Sound wave vibrations and audio signals have a frequency range of 20 to 20,000 cycles per second. Ordinary sound waves travel only a few yards, while a loud fog horn might travel a few miles. Amplified audio signals can be sent over wires (such as your telephone line) as far as the wires will take them.

The Radio Station

Refer to the Radio Station Block Diagram (Illustration Booklet, Page 5) as you read this description.

A radio station takes the audio signal from a microphone, phonograph record, or recorded tape and sends it out through the air on a radio frequency carrier in the following manner.

Radio frequencies are measured in kiloHertz (kHz) or megaHertz (MHz), formerly called kilocycles per second and megacycles per second. "Kilo" means thousand and "mega" means million. The radio frequency spectrum ranges from about 50 kiloHertz to over 1000 megaHertz. Different bands in the radio frequency spectrum are assigned by the Federal Communications Commission (FCC) for various services. For example, the AM broadcast band is from 535 kiloHertz to 1605 kiloHertz, while the Citizens Band (CB) is around 27 megaHertz.

Each radio transmitter (station) is licensed by the FCC to operate at a specific frequency in its band, and is assigned "call letters" that identify the station. The FCC also regulates the amount of power the station may put out, which has an effect on the distance that the radio frequency (RF) signal will travel.

The radio frequency (RF) is generated at the radio station by an electronic "oscillator". This RF is fed through a "modulator" and RF amplifier to an antenna that radiates the RF signal into the surrounding air. The RF signal itself is known as a "carrier" for the audio signals that modulate it.

Amplitude Modulation (AM) and Frequency Modulation (FM) are two methods of placing audio signals on a radio frequency carrier. In AM radio, the amplitude (strength) of the RF carrier is modulated (controlled) by the strength or loudness of the audio signal. In FM radio, the frequency of the RF carrier is made to deviate above and below a center frequency in proportion to the strength of the audio signal.

The Radio Receiver

Your Portable AM Radio is a "superheterodyne" receiver which has an RF amplifier, an oscillator/mixer, intermediate frequency (IF) stage, detector, audio amplifier, and audio output stages. See the AM Radio Receiver Block Diagram (Illustration Booklet, Page 5).

Radio frequency signals that are radiated from the radio station antenna induce a small current in the antenna of a radio receiver. When you "tune in" a radio station, the circuits in the receiver reject all other station frequencies and amplify the station signal that is tuned in. Following is a description of how a superheterodyne receiver works.

Assume you have tuned your Radio dial to "14" (1400 kiloHertz) and are listening to a program. The antenna and RF amplifier circuits pass and amplify this RF signal to a mixer stage. At the same time, the setting of the Radio dial has tuned the oscillator circuit to generate another signal that is 455 kiloHertz (kHz) higher in frequency than the radio station signal, or 1855 kHz. This oscillator signal beats against (heterodynes) the input signal in the Mixer to produce an intermediate frequency of 455 kHz.

All of the "tuning" takes place in the antenna, RF amplifier, and oscillator circuits. The intermediate frequency (IF) stage is set at 455 kHz. and amplifies the IF signal further before applying it to the detector circuit.

The detector circuit demodulates the IF signal, leaving only the audio signal, which is then amplified in the audio driver stage and in the audio output stage. The loudspeaker then converts the amplified audio signal into sound waves with the same characteristics as those that entered the microphone initially.

TECHNICAL DESCRIPTION

NOTE: This portion of the Circuit Description is intended for persons with an electronics background. Refer to the AM Receiver Block Diagram (Illustration Booklet, Page 5) and the Schematic Diagram (Illustration Booklet, Page 6) while you read this Circuit Description.

Your Portable AM Radio is an 8-transistor superheterodyne receiver that tunes to standard AM (Amplitude Modulated) broadcast stations from 535 kHz to 1605 kHz. The circuits in this Radio include: RF amplifier Q1, oscillator-mixer Q2, IF amplifier Q3 and Q4, detector D2 and D3, audio amplifier Q5, audio driver Q6, and push-pull output amplifier Q7 and Q8. Each of these circuits will be described separately.

Tuner — RF Amplifier

Radio frequency (RF) signals transmitted by broadcast stations induce a small current in the ferrite rod antenna (T1). The desired RF signal is selected by varying tuning capacitor C1 which, in parallel with the primary winding of the antenna coil, tunes the antenna circuit. This selected RF signal is coupled through the secondary winding of T1 to the base of RF amplifier transistor Q1. Bias voltage is applied to transistor Q1 through resistor R1 and the AGC (Automatic Gain Control) circuit. The amplified signal is coupled from the collector of transistor Q1 through capacitor C4 to the base of oscillator-mixer transistor Q2.

Oscillator/Mixer

The amplified RF signal is mixed with a local oscillator signal in transistor Q2. Oscillator coil T2, along with capacitors C8, C8A, and C9 determine the frequency of the oscillator signal. Since oscillator tuning

capacitor C8 and antenna tuning capacitor C1 rotate on the same tuning shaft, the oscillator frequency is always 455 kHz higher in frequency than the RF signal. Because of the heterodyning of the RF and oscillator signals, the mixer produces signals both higher and lower than the oscillator signal. That is, the sum of the RF signal and local oscillator (RF+LO), and the difference (RF−LO). The difference signal is the IF (Intermediate Frequency) of 455 kHz. IF transformer T3 contains a tuned circuit that passes only the 455 kHz IF signal to filter F1.

IF Amplifiers

Filter F1 passes only 455 kHz and rejects or filters other frequencies. This filtered IF signal is applied to the base of IF amplifier transistor Q3, which is biased by voltage divider resistors R13 and R14. Transistors Q3 and Q4 are direct-coupled and amplify the IF signal before applying it to a second IF filter, F2, which further filters the IF signal.

Detector

Detector diodes D2 and D3 convert the IF signal into a DC voltage that varies in amplitude at an audio frequency rate. During the conversion, diode D2, resistors R22 and R24, and capacitors C15 and C17 remove the 455 kHz portion of the IF signal. The audio signal that remains has a DC level that is proportional to the strength of the received radio station signal. This DC voltage is used for automatic gain control as explained in the following paragraph.

AGC (Automatic Gain Control)

To prevent strong radio signals from being too loud, or weak signals too low to hear, an automatic gain control (AGC) circuit uses the DC component of the detected audio signal to control the gain of the RF amplifier transistor. Resistor R23 picks off the DC component from the detector circuit. Capacitor C16 filters the audio and prevents sudden changes in the AGC voltage. This voltage is applied to the base of RF amplifier transistor Q1 to vary its bias (and gain) inversely with the strength of the received RF signal.

Audio Amplifier — Audio Driver

Capacitor C18 removes the DC voltage from the detected audio signals. The audio signals from the detector are then coupled through Volume Control R25, capacitor C22 and resistor R26 to the base of audio amplifier transistor Q5, which is direct-coupled to the base of driver transistor Q6. Transistor Q5 amplifies the audio signal and transistor Q6 drives the output amplifier.

Push-Pull Output Amplifier

Driver transistor Q6 is direct-coupled to the base of transistor Q8, and through diodes D4, D5, D6, and D7 to the base of transistor Q7. This is a push-pull circuit that provides the current amplification needed to drive the loudspeaker. The push-pull action occurs as transistors Q7 and Q8 alternately conduct or are cut off by the negative-going or positive-going portions of the audio signal from the collector of driver transistor Q6.

A negative-going audio signal at the base of transistor Q8 causes the transistor to conduct. When the audio signal at the base of Q8 goes positive, the transistor is cut off and Q7 conducts. Capacitor C26 charges to half the supply voltage when the radio is first turned on. Its high capacitance prevents the capacitor from charging or discharging when the speaker is driven at audio frequencies.

CIRCUIT BOARD X-RAY VIEW

NOTE: To identify a part shown in this View, so you can order a replacement, proceed in either of the following ways:

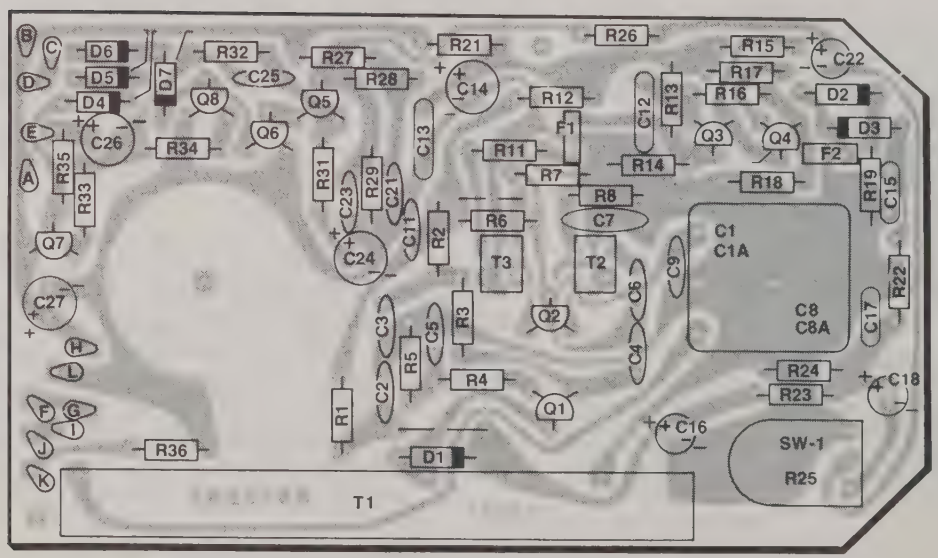
1. A. Refer to the place where the part is installed in the Step-by-Step instructions and note the "Description" of the part (for example: 2200 Ω, .05 μF, or 2N4121).

   B. Look up the Description in the "Parts List."

2. A. Note the identification number of the part (R-number, C-number, etc.)

   B. Locate the same identification number (next to the part) on the Schematic. The "Description" of the part will also appear near the part.

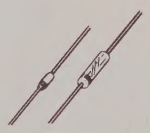
   C. Look up this Description in the "Parts List."



X-RAY VIEW
(Viewed from Component Side)

TRANSISTOR-DIODE IDENTIFICATION CHART

DIODES

COMPONENT NO.	HEATH PART NO.	TYPE NO.	IDENTIFICATION
D1, D2, D3	56-26	1N191	
D4, D5, D6, D7	56-56	1N4149	

TRANSISTORS

COMPONENT NO.	HEATH PART NO.	TYPE NO.	IDENTIFICATION
Q1, Q2, Q3, Q6	417-801	MPSA20	
Q4, Q5	417-235	2N4121	
Q7	417-881	MPSA13	
Q8	417-885	MPSA65	

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

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ZENITH

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MA22745

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